

AD-A106 511

HOSKINS-WESTERN-SONDEREGGER INC LINCOLN NE

F/G 13/13

NATIONAL DAM SAFETY PROGRAM. TRENTON UPPER LAKE DAM (MO 10365),--ETC(U)

AUG 79 R S DECKER, G ULMER, H P HOSKINS

OACW43-79-C-0046

NL

UNCLASSIFIED



END
DATE
12 H
DTIC

LEVEL II

GRAND-CHAMPTON DAM

AD A106511

**TRENTON UPPER LAKE DAM
CRANEY COUNTY, MISSOURI
NO. 1000**

**PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM**

FILE COPY



**United States Army
Corps of Engineers
St. Louis District**

St. Louis District

**DTIC
ELECTE**

NOV 2 1981

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

APPROVED BY:

81 10 26 058

**Approved for public release
Distribution Unlimited**

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
	AD A106 511	
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Trenton Upper Lake Dam (MO 10365) Grundy County, Missouri		5. TYPE OF REPORT & PERIOD COVERED Final Report
6. AUTHOR(s) HOSKINS-WESTERN-SONDERGGER, INC.		7. PERFORMING ORG. REPORT NUMBER
		8. CONTRACT OR GRANT NUMBER(s)
		DAON43-79-C-0046
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 1.1.1
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		12. REPORT DATE August 1979
13. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) National Dam Safety Program, Trenton Upper Lake Dam (MO 10365), Grand - Chariton Basin, Grundy County, Missouri. Phase I Inspection Report.		14. NUMBER OF PAGES Approximately 45
15. SECURITY CLASS. (of this report)		16. SECURITY CLASS. (of this report)
		UNCLASSIFIED
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		18. DECLASSIFICATION/DOWNGRADING SCHEDULE
Approved for release; distribution unlimited.		
19. SUPPLEMENTARY NOTES		
20. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety, Lake, Dam Inspection, Private Dams		
21. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

FORM 1 JAN 73 1073 SECTION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)



DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD NORTH
ST. LOUIS, MISSOURI 63101

FORM 1 TO
AT 700-700-107

SUBJECT: Trenton Upper Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Trenton Upper Lake Dam:

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

- 1) Spillway will not pass 50 percent of the Probable Maximum Flood.
- 2) Overtopping could result in dam failure.
- 3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY SIGNED 24 MAR 1980
Chief, Engineering Division Date

APPROVED BY SIGNED 24 MAR 1980
Colonel, CE, District Engineer Date

Accession For	
DTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A	

DTIC
ELECTE
S NOV 2 1981 D

TRENTON UPPER LAKE DAM
GRUNDY COUNTY, MISSOURI
MO. 10365

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
FOR
GOVERNOR OF MISSOURI

AUGUST, 1979

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

TABLE OF CONTENTS

<u>PARAGRAPH NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
	Assessment Summary	
	Overview Photograph	
SECTION 1 - PROJECT INFORMATION		
1.1	General	1
1.2	Description of Project	1
1.3	Pertinent Data	3
SECTION 2 - ENGINEERING DATA		
2.1	Design	5
2.2	Construction	5
2.3	Operation	5
2.4	Evaluation	5
SECTION 3 - VISUAL INSPECTION		
3.1	Findings	6
3.2	Evaluation	8
SECTION 4 - OPERATIONAL PROCEDURES		
4.1	Procedures	9
4.2	Maintenance of Dam	9
4.3	Maintenance of Operating Facilities	9
4.4	Description of Any Warning System in Effect	9
4.5	Evaluation	9
SECTION 5 - HYDRAULIC/HYDROLOGIC		
5.1	Evaluation of Features	10
SECTION 6 - STRUCTURAL STABILITY		
6.1	Evaluation of Structural Stability	12
SECTION 7 - ASSESSMENT/REMEDIAL MEASURES		
7.1	Dam Assessment	13
7.2	Remedial Measures	14

APPENDIX A - MAPS

Plate A-1	Vicinity Topography
Plate A-2	Location Map

APPENDIX B - PHOTOGRAPHS

Plate B-1	Photo Index
Plate B-2	Photo No. 2 - Crest From Left Abutment
	Photo No. 3 - Upstream Slope From Left Abutment
Plate B-3	Photo No. 4 - Downstream Slope From Left End
	Photo No. 5 - Eroded Section At Sta. 2 + 00±
Plate B-4	Photo No. 6 - View Upstream From Sta. 4 + 00
	Photo No. 7 - View Downstream From Sta. 4 + 50 Showing Trenton Lower Lake
Plate B-5	Photo No. 8 - View Of Road Crossing Dam. Note Longitudinal Crack.
	Photo No. 9 - Downstream Slope From Right End
Plate B-6	Photo No. 10 - Downstream Slope Showing Berm Or Deformation
	Photo No. 11 - Seep Area At Sta. 5 + 00
Plate B-7	Photo No. 12 - Overview From Left Side Upstream
	Photo No. 13 - Upstream Slope From Right Side
Plate B-8	Photo No. 14 - Spillway Entrance
	Photo No. 15 - View Downstream In Spillway Outlet For 50" x 31" Pipe Arch.
Plate B-9	Photo No. 16 - Outlet Channel For Spillway. Rod In Channel From 50" x 31" Pipe Arch. 21" Pipe In Foreground
	Photo No. 17 - View Upstream In Outlet Channel From 50" x 31" Pipe Arch
Plate B-10	Photo No. 18 - Outlet Channel Drops Into Gully

APPENDIX C - PROJECT PLATES

Plate C-1	Phase I - Plan And Centerline Profile Of Dam
Plate C-2	Phase I - Section Of Dam At Sta. 5 + 00
Plate C-3	Phase I - Profile And Elevation of Spillway

APPENDIX D - HYDRAULIC AND HYDROLOGIC DATA

Plates D-1 and D-2	Hydrologic Computations
Plate D-3	Spillway Rating Curve
Plate D-4	Discharge-Ratio Curves
Plates D-5 to D-18	Computer Input And Output For Ratios of PMF

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Trenton Upper Lake Dam
State Located	Missouri
County Located	Grundy County
Stream	Tributary to Muddy Creek
Date of Inspection	August 14, 1979

Trenton Upper Lake Dam was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderregger, Inc. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and developed with the help of several Federal and State agencies, professional and engineering organizations, and private engineers. Based on these guidelines, this dam is classified as an intermediate size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends approximately three miles downstream of the dam. Within the damage zone are the 115 acre surface acre Trenton Lower Lake, 20 or more trailer homes, 2 or 3 business buildings, the Trenton Airport and Highway 65.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the recommended guidelines for an intermediate dam having a high hazard potential. The Probable Maximum Flood is the appropriate spillway design flood. The spillway will pass the 100-year flood (flood having a one percent chance of being exceeded in any year) without overtopping the dam. The spillway will pass 37% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Failure of this dam by overtopping or by structural instability would release the water from Trenton Upper Lake directly into Trenton Lower Lake and would undoubtedly cause overtopping of Trenton Lower Lake Dam and possibly failure of that dam.

It is recommended that the following be pursued on a high priority basis:

a. Increase the height of the dam and/or the size of the spillway in order to pass the probable maximum flood without overtopping the dam.

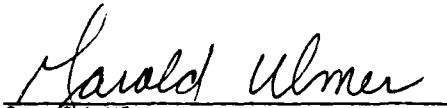
b. Conduct engineering studies to determine the cause and extent of the slide or deformation on the downstream slope of the dam and design protective measures if required.

c. Conduct seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" to be used in performing the work described in a. and b. above and also to be made a part of the record.

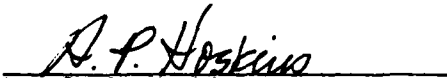
Maintenance has been lax as evidenced by the growth of trees on the slopes of the dam, erosion in areas along the upstream slope and severe erosion in the spillway outlet channel. Maintenance procedures concerned with the foregoing are recommended in Paragraph 7.2b of this report.



Rey S. Decker
E-3703



Harold Ulmer
E-4777



Harold P. Hoskins
Chairman of Board
Hoskins-Western-Sonderegger, Inc.
E-8696



PHOTO NO. 1 OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
TRENTON UPPER LAKE DAM - MO 10365
GRUNDY COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Trenton Upper Lake Dam be made.
- b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.
- c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams", dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dam and Appurtenances.
 - (1) The dam is an earth fill approximately 1300 feet in length and 31 feet in height located in the northern Missouri Loess-Till area. Soils in the area consist of loess (CL) over fine grained glacial till (CL or CH) on the rolling hill uplands with glacial till (CL-CH) exposed on the steeper valley slopes.

- (2) The spillway consists of two corrugated metal pipes (CMP) located on the right (north) abutment which discharges into Trenton Lower Lake (MO. 10366).
- (3) Pertinent physical data are given in paragraph 1.3 below.
- b. Location. The dam is located in the central part of Grundy County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the SE $\frac{1}{4}$ of Section 15, T61N, R24W. The lake formed behind the dam is shown in the SE $\frac{1}{4}$ of Section 15, T61N, R24W and the W $\frac{1}{2}$ of Section 14, T61N, R24W.
- c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment is in the intermediate size category.
- d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c. above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends approximately three miles downstream from the dam. Within the damage zone are the 115 surface acre Trenton Lower Lake, 20 or more trailer homes, 2 or 3 business buildings, the Trenton Airport and Highway 65.
- e. Ownership. The dam is owned by the Trenton Lake Association, c/o Mr. J. Martin, President, Martin Town and Country, Hwy 65, Trenton, Missouri 64683.
- f. Purpose of Dam. The dam impounds a 63 acre lake for recreation and flood retardation.
- g. Design and Construction History. It was reported by Mr. Blackburn, Trenton City Administrator, that the dam was constructed in 1963 by Fred Payne. No other design or construction history was available.
- h. Normal Operating Procedure. There are no operating facilities for this dam. The pool level is controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillway.

1.3 PERTINENT DATA

- a. Drainage Area. 577 acres (0.90 square miles).
- b. Discharge at Damsite.
 - (1) All discharges at the damsite are through an uncontrolled spillway consisting of a 50"x 31" corrugated metal pipe arch culvert and a 21" corrugated metal pipe culvert laid approximately parallel with inverts at the same elevation.
 - (2) Estimated maximum flood at damsite - unknown.
 - (3) The spillway capacity varies from 0 c.f.s. at elevation 784.0 feet to 109 c.f.s. at the minimum top of dam (elevation 791.0 feet).
 - (4) Total spillway capacity at the minimum top of dam is 109 c.f.s. \pm
- c. Elevations (feet above M.S.L.).
 - (1) Top of dam (low point) - 791.0
 - (2) Spillway crest - 784.0
 - (3) Streambed at centerline - 760 \pm (from U.S.G.S. Quad Sheet)
 - (4) Maximum tailwater - unknown
- d. Reservoir. Length (feet) of maximum pool - 3600 \pm
- e. Storage (Acre-feet).
 - (1) Top of dam - 1250 \pm
 - (2) Spillway crest - 690 \pm
- f. Reservoir Surface (Acres).
 - (1) Top of dam - 90 \pm
 - (2) Spillway crest - 63 \pm
- g. Dam.
 - (1) Type - earth fill
 - (2) Length - 1325 feet \pm
 - (3) Height - 31 feet \pm
 - (4) Top width - 24 foot asphaltic concrete surfaced roadway on 33 to 36 foot width.
 - (5) Side slopes.
 - (a) Downstream - varies from 1.8H to 6.9H on 1V; overall = 2.8H on 1V (see Plate C-2)
 - (b) Upstream - 1.4H on 1V on exposed section

- (6) Zoning - unknown
- (7) Impervious core - unknown
- (8) Cutoff - unknown
- (9) Grout curtain - unknown
- (10) Wave protection - limestone riprap.
- (11) Internal drainage - unknown

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal (and only)

- (a) Type - Two uncontrolled CMP culverts,
one 21-inch diameter, one 50"x 31" arch.
- (b) Invert elevation - Both set at 784.0 feet
Outlet elevation - 21 in. = 776.8 feet
51 x 31 in. = 783.6 feet
- (c) Length - 21 in. = 160 feet +
51 x 31 in. = 60 feet.
- (d) Upstream Channel - Direct from reservoir
into spillway conduits.
- (e) Downstream (exit) channel - Partially
paved with rough concrete grout thence
into eroded earth channel

j. Regulating Outlets. None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. It was reported by Mr. Blackburn that the dam was constructed in 1963 by Mr. Fred Payne.

2.3 OPERATION

No data were available on spillway operation.

2.4 EVALUATION

- a. Availability. No data were available.
- b. Adequacy. The field surveys and visual observation presented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General. A visual inspection of Trenton Upper Lake Dam was made on August 14, 1979. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: R. S. Decker, Geotechnical and Garold Ulmer, Hydrology. This inspection was conducted in the rain. No one representing the owner was present during the inspection.

b. Dam.

- (1) Geology and Soils (Abutment and Embankment). Soils on the abutments consist of thin loess and loessial colluvium over fine grained glacial till (TH). Glacial till is exposed in the spillway exit channel on the right (north) abutment. Materials in the embankment appear to be plastic clay (CL or CH) probably borrowed from both abutments. No cracks, slumps or seepage were observed in the abutments.

Foundation materials consist of alluvium derived from loess and till underlain at some depth by limestone and/or shale of the Middle Pennsylvanian System.

- (2) Upstream Slope. The upstream slope is adequately covered with durable limestone riprap up to 3 feet in size and waste concrete rubble. The riprap extends almost to the crest of the dam in some places and to elevations 2 or 3 feet below the crest in other locations. Some erosion was noted above the riprap in those areas where riprap did not extend to the crest (see Photo No. 5). Several trees, up to 4 inch diameter, are growing on the slope. Many smaller willows had been recently cut along the upstream side. No indications of cracks or deformations were observed. No rodent burrows were noted.
- (3) Crest. The crest serves as a roadway with a 24 foot wide asphaltic concrete surface. Longitudinal cracks were observed along the downstream crest line (in the roadway and shoulder) between stations 5+20 and 6+20

which appeared to result from sliding or slumping of the downstream section (see Photo No. 3).

The cracks were 0.5 to 0.75 inches in width and vertical displacement varied from about 1 to 2 inches.

The profile of the crest is quite uneven with a general slope from the left to the right abutment (south to north) with the right end of the dam some 5 to 6 feet lower than the left end.

- (4) Downstream Slope. The downstream slope, particularly on the left (south) one half, of the dam is heavily overgrown with brush and trees up to 8 inches in diameter. The open areas are well vegetated with adapted grasses and clover. The cross sectional profile of the downstream slope is quite irregular with approximately 2H on 1V slopes in the upper and basal sections and much flatter slopes (3H to 6H on 1V) in the central section, producing a berm like appearance when viewed longitudinally (see Photo No. 10). It appeared that most of the dam had been constructed with a berm about midway down the slope except in the area downstream from stations 5+00 to 6+00+ where some lateral deformations may have occurred. A seep area was noted downstream from Station 5+00 which extended from about Station 5+00 to 6+00 and outcropped at about elevation 775. (This is the possible slump area.) No seepage effluent was observed, but the area was covered with water-loving vegetation. The presence of seepage along the toe of the dam was difficult to detect since Trenton Lower Lake nearly encroaches upon the downstream toe of this dam. A few very small seeps were observed just above the Lower Lake level (elevation 753+) downstream from about Station 2+50 toward the left abutment. All seepage was clear, and the detectable seepage discharge was estimated at or less than 0.5 gpm. Borings on the slope showed gray, brown clay (CH) material to a depth of 2 feet or more.

c. Appurtenant Structures.

- (1) The spillway is uncontrolled and consists of two corrugated metal culverts, one 21 inches in diameter, the other an arch 50 in. x 31 in., located on the right abutment of the dam. The spillway culverts exit into an excavated channel that is partially paved with rough concrete grout. All spillway discharges feed directly into Trenton

Lower Lake. The earth channel (gully) downstream from the paved section is badly eroded. The arch culvert is open and in good shape. It was not possible to see through the smaller pipe from one end to the other. There was no evidence of recent discharges through the spillway. Neither culvert had a trash rack over the inlet; however, the short approach channel was clear of trash and brush.

- (2) Drawdown Facilities. No drawdown facilities were observed for this dam.

d. Reservoir Area. The shoreline around the reservoir is well grassed and no significant erosion was observed.

e. Downstream Channel. Discharges from this reservoir flow directly into Trenton Lower Lake.

3.2 EVALUATION.

This structure appears to be in fairly good shape. Additional studies would be required to determine the nature, extent and potential hazard of the apparent deformation of the downstream slope between stations 5+00 and 6+00+. Tree growth on the slopes and erosion of the upstream slope above the riprap and in the spillway exit channel impose a potential of failure of this structure unless corrected. Installation of trash racks on the spillway culverts would assure more efficient operation.

The nature of materials in the dam, the paved roadway, and the dense vegetative cover indicate that overtopping by the PMF should not cause serious damage to the dam but could cause considerable damage in the right abutment trough (spillway exit).

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam. The pool level is controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

Some willow trees had been recently cut on the upstream slope. Other tree growth on both slopes and erosion on the upstream slope and in the spillway exit channel indicate considerable laxity in maintenance of this dam.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

The lack of regular inspection and maintenance of this structure could lead to serious potential of failure.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data. No design data were found for this dam.
- b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Trenton, Missouri 15 minute topographic quadrangle map, and the Trenton SE, Missouri 7.5 minute series orthophotoquad. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection.
- c. Visual Observations.
 - (1) The spillway releases directly into Trenton Lower Lake, and the lower reservoir water surface is at the toe of Trenton Upper Lake Dam.
 - (2) The inlets to both the spillway CMP culverts were clear of debris. However, it could not be determined if the smaller of the two pipes was free of obstructions throughout the full length of the tube.
 - (3) There was no evidence of overtopping of this structure.
- d. Overtopping Potential. The spillway is too small to pass the probable maximum flood without overtopping. The spillway will pass 37% of the PMF and the 100-year flood without overtopping. This dam could probably withstand overtopping by the probable maximum storm without significant damage. The results of the routings through the dam are tabulated in regards to the following conditions:

<u>Frequency</u>	<u>Inflow Discharge c.f.s.</u>	<u>Outflow Discharge c.f.s.</u>	<u>Maximum Pool Elevation</u>	<u>Freeboard Top of Dam Min. Elev. 791.0</u>	<u>Time Dam Overtopping Hr.</u>
100 Yr.	2060	60	787.1	+3.9	-
0.5 PMF	3200	330	791.9	-0.9	7.0+
PMF	6400	4600 *	793.6	-2.6	9.0-
0.37 PMF	2400	110	791.0	0	-

* (Maximum discharge overtopping the dam = 4,470 cfs;
maximum spillway discharge = 130 cfs.)

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and an intermediate size. Therefore, the PMF is the test for the adequacy of the dam and its spillway.

The estimated damage zone is described in Paragraph 1.2d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observation. Longitudinal cracks along the downstream crest line, the very uneven surface profile of the downstream slope between Stations 5+00 and 6+00+ and the apparent presence of seepage would indicate possible lateral deformation in this area of the dam. The remainder of the dam appears to be structurally stable. Minor seepage at the toe of the dam toward the left end is probably following the old loess-till interface of the left abutment and does not appear to seriously endanger the stability of the structure.
- b. Design and Construction Data. No design or construction data were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
- c. Operating Records. There are no controlled operating facilities for this dam.
- d. Post Construction Changes. It would appear that the larger spillway culvert (50"x 31") was installed sometime after the smaller culvert. It is not known when this modification was made.
- e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of the magnitude predicted in this area would not ordinarily be expected to cause structural failure of this dam. However, the apparent instability of portions of the downstream slope could be accentuated by such seismic activity, and stability analyses should consider appropriate seismic forces.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

- a. Safety. The longitudinal cracks in the crest, and the apparent seepage and deformation in the downstream slope indicate that this dam may not be structurally stable under maximum loading conditions. A failure of this upper dam at maximum pool level would probably cause overtopping of Trenton Lower Lake Dam by several feet.

Using the approximate data available for analyses, this dam will be overtopped with a water depth of 2.6 feet for about 9 hours by the Probable Maximum Flood. The effects of such overtopping on erosional and structural stability are not known.

Deficiencies in maintenance, consisting of tree growth on embankment slopes and erosion on the upstream face and in the spillway exit, could lead to potential failure of the dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

- b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report are based upon performance history and visual observations. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.
- c. Urgency. The analyses and remedial measures recommended in paragraph 7.2a. should be pursued on a high priority basis.
- d. Necessity for Phase II. Phase II investigation is not considered necessary. The additional studies and analyses recommended in paragraph 7.2a. should be accomplished in the near future.
- e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of this magnitude is not ordinarily expected to be hazardous to a dam of this size and character. However seismic stresses should be considered in the stability analyses of this dam.

7.2 REMEDIAL MEASURES

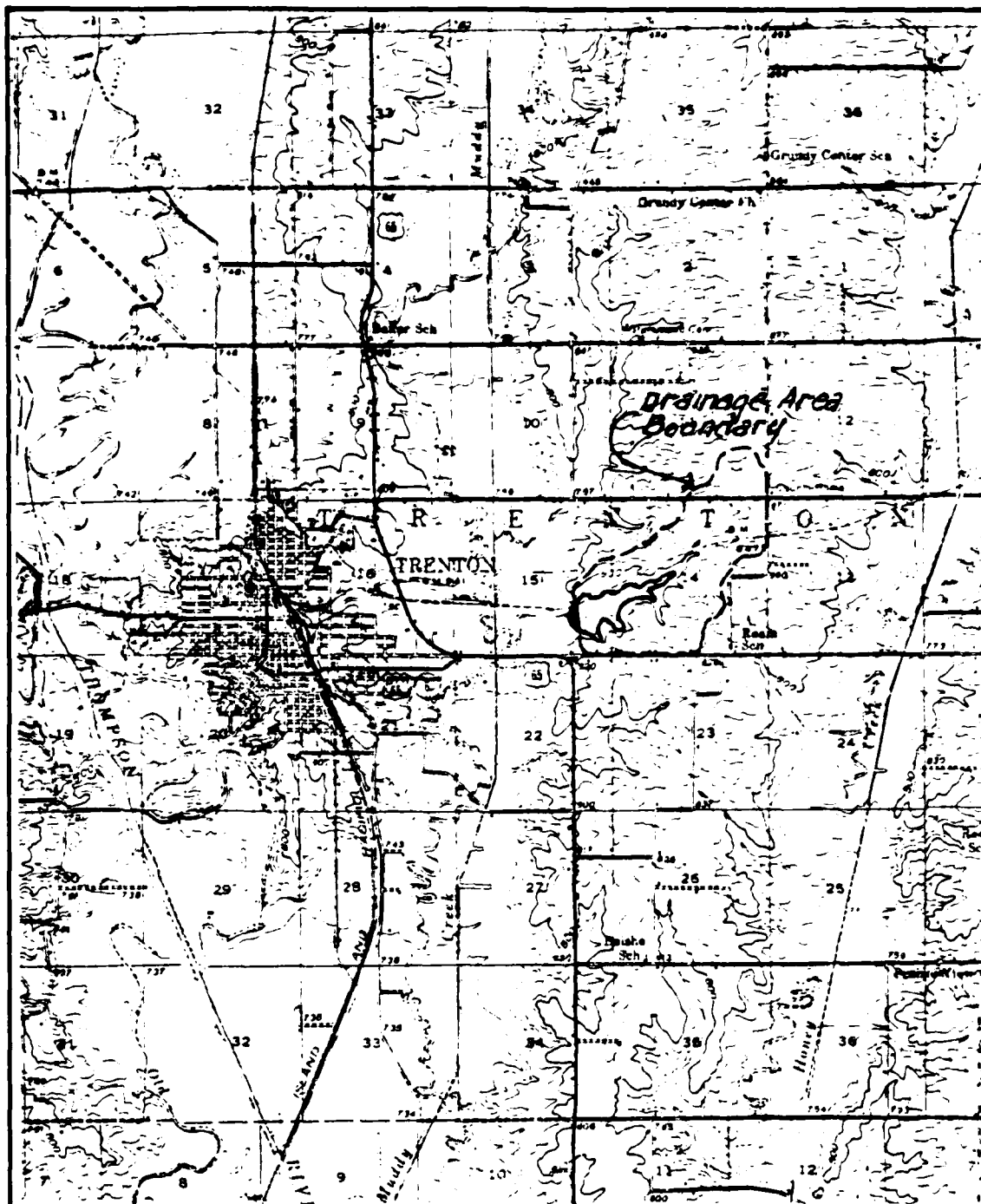
a. Alternatives.

- (1) Additional information should be obtained on the topographic characteristics of the reservoir area to determine the increase in the height of dam or the size of the spillway that is necessary to pass the Probable Maximum Flood without overtopping the dam.
- (2) Additional studies should be performed to determine the cause, extent and potential effects of the apparent slide or deformation of the downstream slope.
- (3) The services of an engineer experienced in the design and construction of dams should be obtained to provide seepage and stability analyses (including seismic stresses) of the present dam and to perform and evaluate the aforementioned additional studies (7.2a.(1), (2)) and to design protective measures, if required.

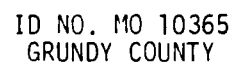
b. O and M Procedures.

- (1) Trees should be removed from the slopes of the dam and measures initiated to prevent their recurrence. Removal of large trees should be done under the guidance of an engineer experienced in the design and construction of earthen dams.
- (2) Erosion in the spillway exit channel and on the upstream slope of the dam should be corrected.
- (3) A program of periodic inspection and maintenance of the structure should be initiated to control the above mentioned (or other) deficiencies.

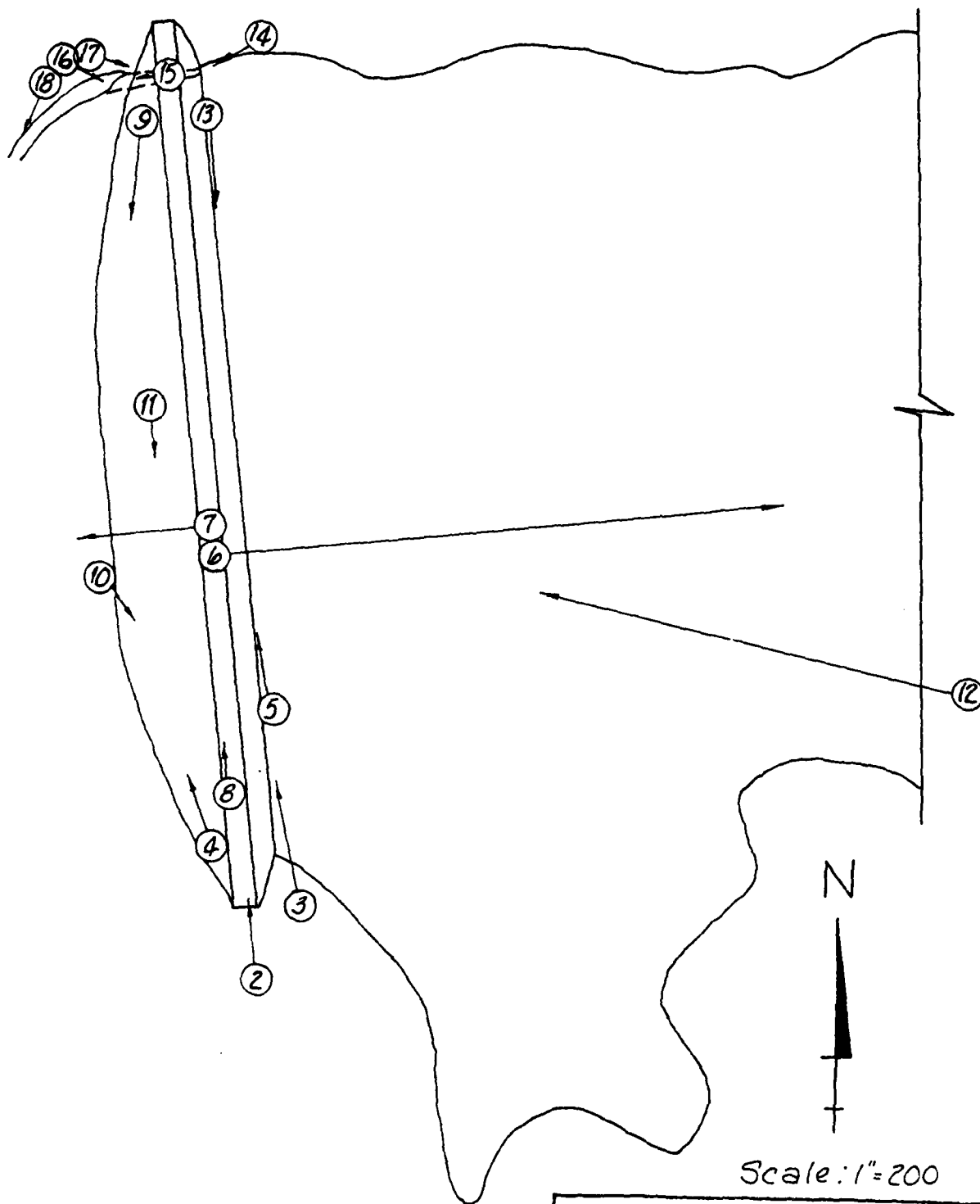
APPENDIX A
MAPS



<p>Scale in feet</p> <p>5000 2500 0 5000 10000</p> <p>Contour Interval 20 Feet</p>	<p>N</p> <p>VICINITY TOPOGRAPHY</p> <p>TRENTON UPPER LAKE DAM</p> <p>GRUNDY COUNTY, MISSOURI</p> <p>MO. 10365</p> <p>PLATE A-1</p>
--	--



APPENDIX B
PHOTOGRAPHS



Scale: 1"=200

PHOTO INDEX
TRENTON UPPER LAKE DAM
GRUNDY COUNTY, MISSOURI
MO. 10365 PLATE B-1



PHOTO NO. 2 - CREST FROM LEFT ABUTMENT



PHOTO NO. 3 - UPSTREAM SLOPE FROM LEFT ABUTMENT



PHOTO NO. 4 - DOWNSTREAM SLOPE FROM LEFT END



PHOTO NO. 5 - ERODED SECTION AT STA. 2 + 00±

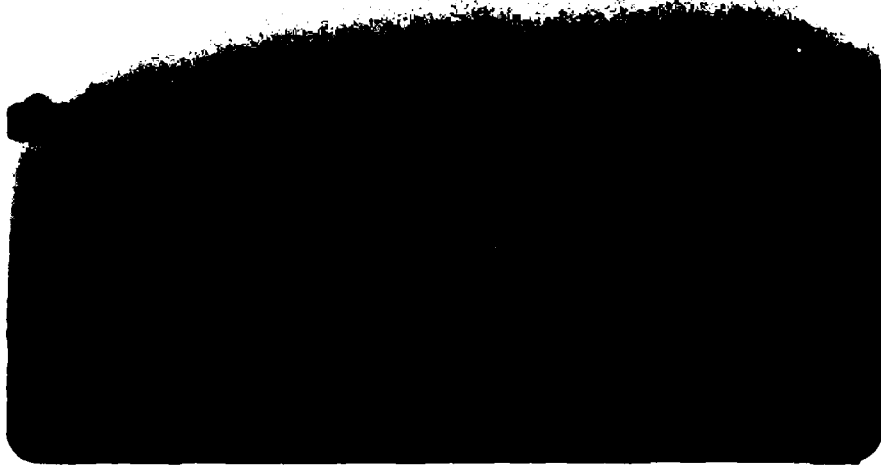


PHOTO NO. 6 - VIEW UPSTREAM FROM STA. 4 + 00



PHOTO NO. 7 - VIEW DOWNSTREAM FROM STA. 4 + 50
SHOWING TRENTON LOWER LAKE



PHOTO NO. 8 - VIEW OF ROAD CROSSING DAM.
NOTE LONGITUDINAL CRACK.



PHOTO NO. 9 - DOWNSTREAM SLOPE FROM RIGHT END



PHOTO NO. 10 - DOWNSTREAM SLOPE SHOWING BERM OR DEFORMATION



PHOTO NO. 11 - SEEP AREA AT STA. 5 + 00



PHOTO NO. 12 - OVERVIEW FROM LEFT SIDE UPSTREAM



PHOTO NO. 13 - UPSTREAM SLOPE FROM RIGHT SIDE

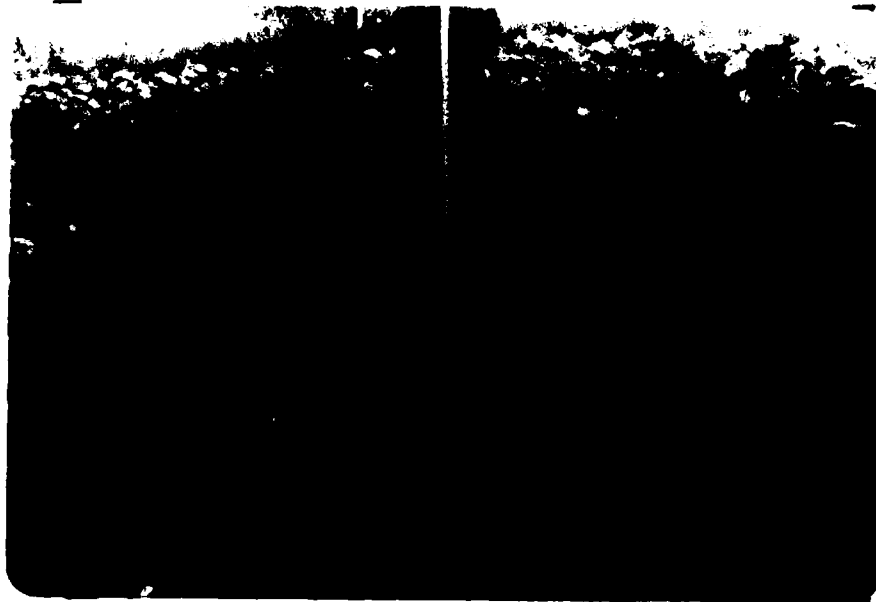


PHOTO NO. 14 - SPILLWAY ENTRANCE

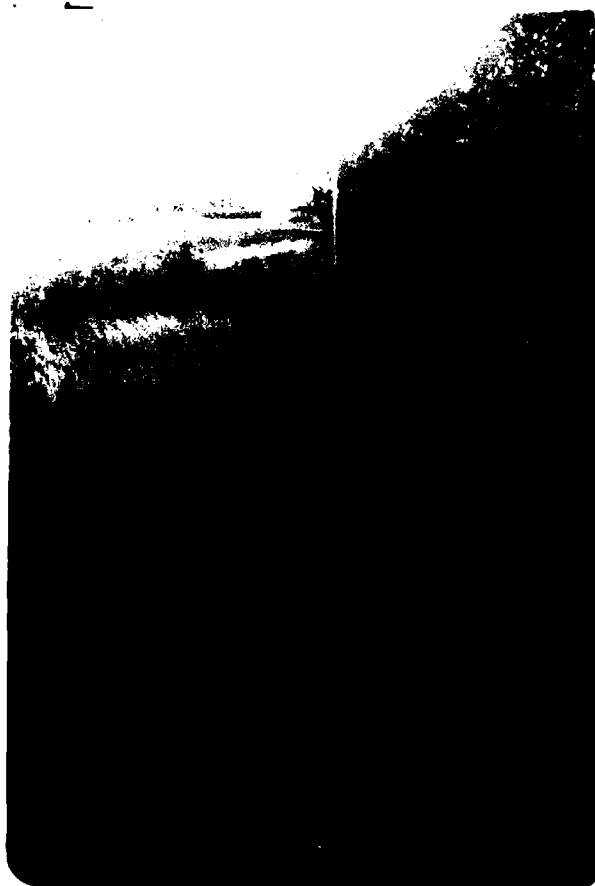


PHOTO NO. 15 -
VIEW DOWNSTREAM IN
SPILLWAY OUTLET FOR
50" x 31" PIPE ARCH



PHOTO NO. 16 - OUTLET CHANNEL FOR SPILLWAY. ROD IN CHANNEL
FROM 50" x 31" PIPE ARCH. 21" PIPE IN
FOREGROUND



PHOTO NO. 17 - VIEW UPSTREAM IN OUTLET CHANNEL FROM
50" x 31" PIPE ARCH

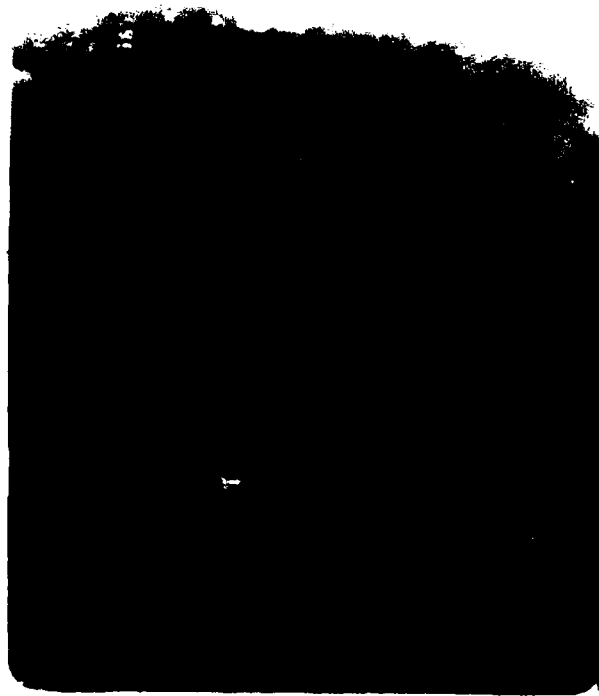


PHOTO NO. 18 -

OUTLET CHANNEL DROPS
INTO GULLY

PLATE B-10

APPENDIX C
PROJECT PLATES

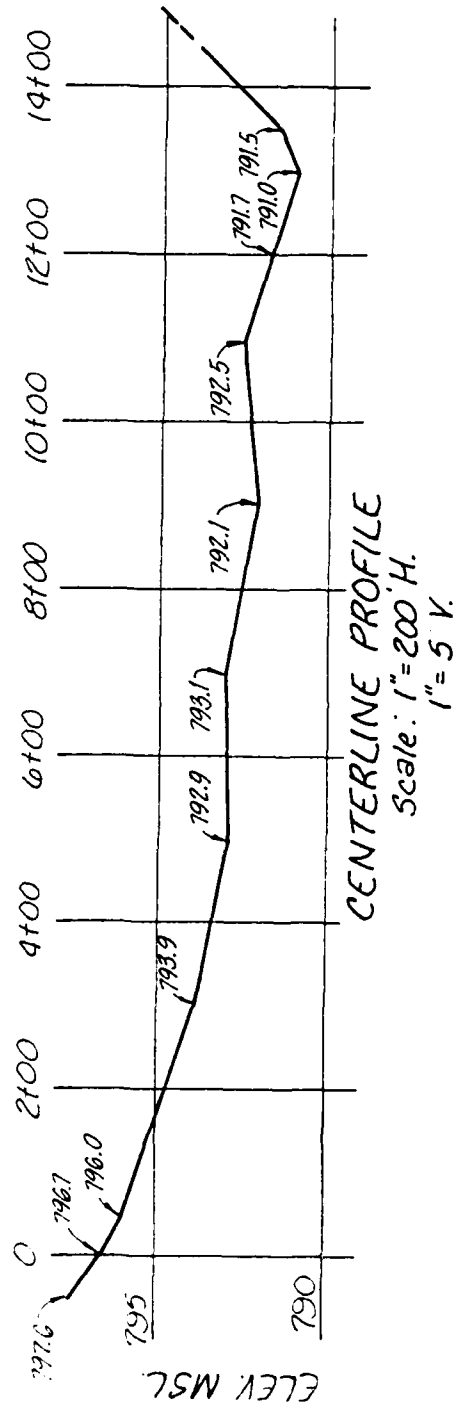
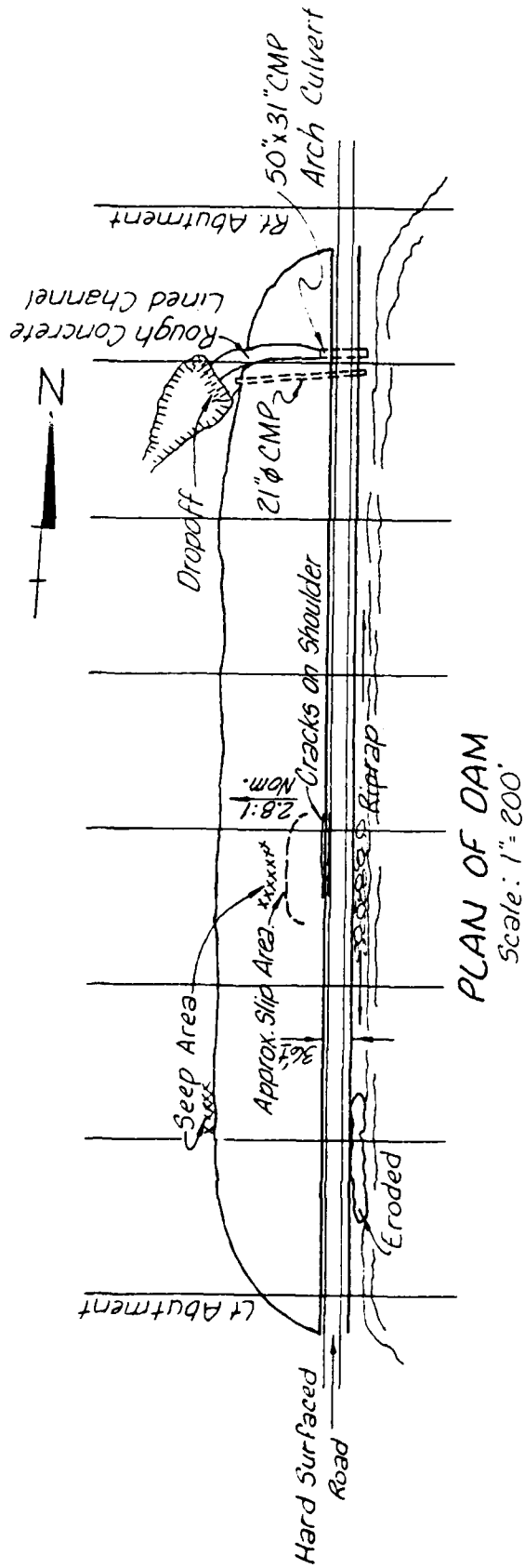
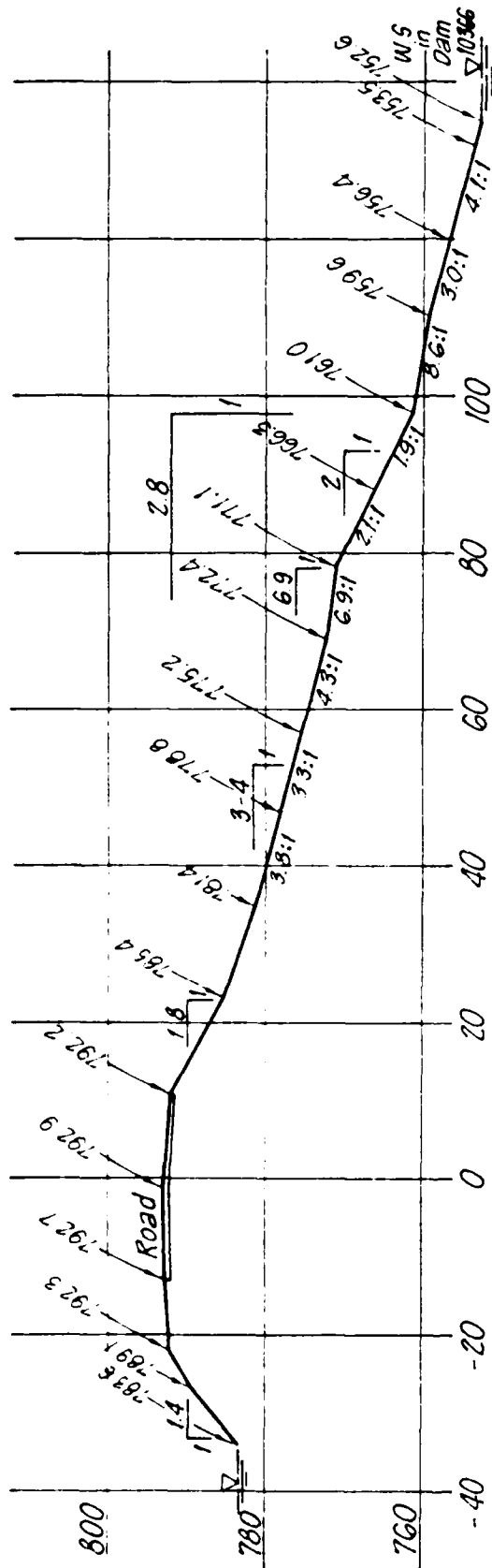
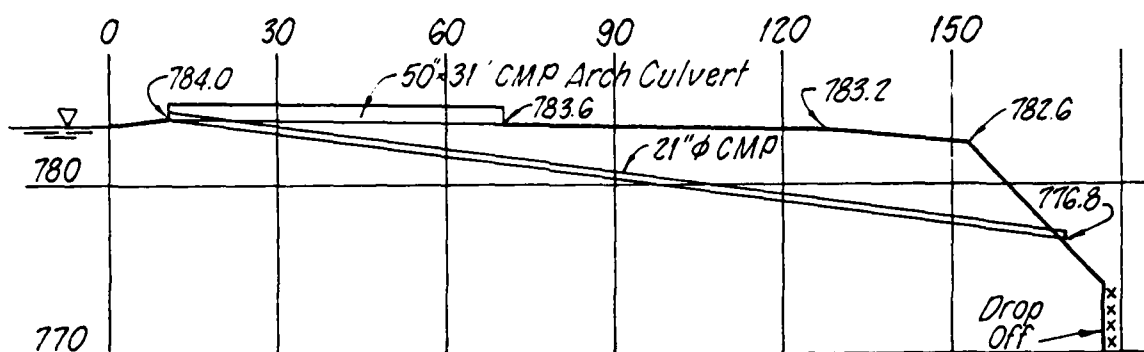


PLATE C-1

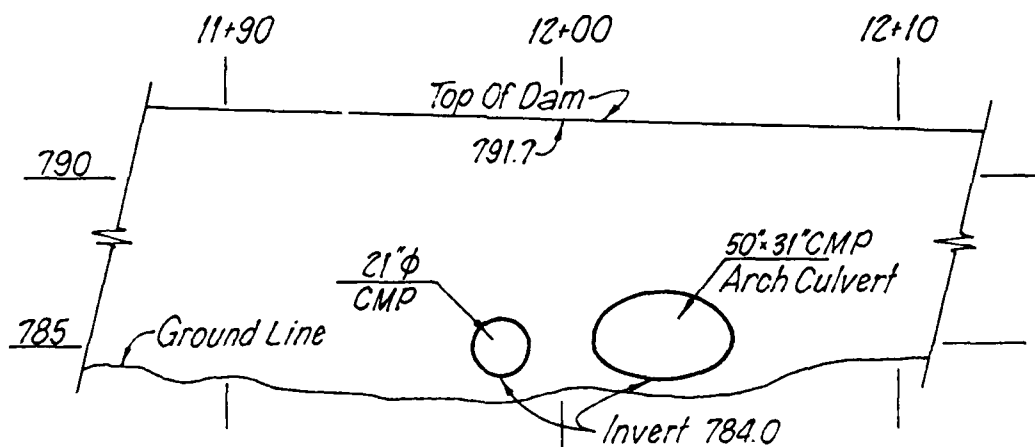


DAM SECTION AT STA. 5+00



PROFILE OF SPILLWAY

Scale: 1" = 3.0' H.
1" = 5.0' V.



SPILLWAY ELEVATION

Scale: 1" = 5'

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

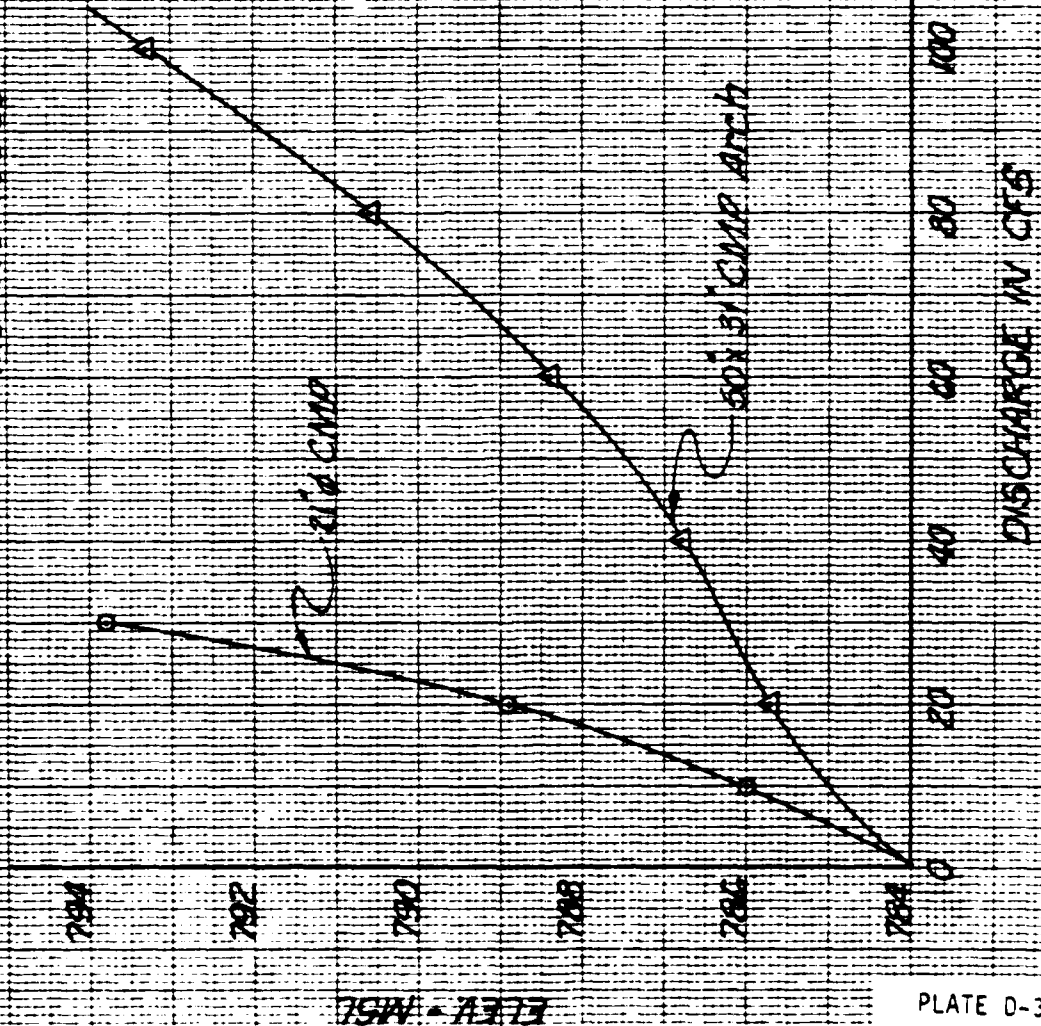
HYDROLOGIC COMPUTATIONS

1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs.
 - a. Twenty-four hour, 100-year rainfall for the dam location was taken from the data for the rainfall station at Maryville, Missouri as supplied by the St. Louis District, Corps of Engineers per their letter dated 6 March 1979. The twenty-four hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis District policy and guidance for hydraulics and hydrology.
 - b. Drainage area = 0.90 square miles (577 acres).
 - c. Time of concentration of runoff = 47 minutes (computed from "Kirpich" formula).
 - d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the 100-year precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the crest of the spillway.
 - e. The total twenty-four hour storm duration losses for the 100-year storm were 1.64 inches. The total losses for the PMF storm were 0.75 inches. These data are based on SCS runoff curve No. 94 and No. 36 for antecedent moisture conditions SCS AMC III and AMC II, respectively. The watershed is composed of primarily SCS soil groups C & D and consists of the following approximate percentages of land use, 10% reservoir area, 20% urban, 10% woodland, 60% cropland.
 - f. Average soil loss rates = 0.05 inch per hour, approximately.
2. The discharge ratings for the spillway were developed using nomographs from HEC No. 5, Highway Culverts, FHWA, assuming inlet control with projecting entrance conditions, and specified size and shape.

The flows over the dam crest were developed using the HEC-1 (Dam Safety Version) program with a discharge coefficient of 2.9 and a value of 1.5 for the exponent of head.

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillway and dam embankment crest. The input-output for several ratios of the PMF and the plotted hydrograph for the PMF are shown in this Appendix.

UPPER TRENTON DAM
NO. 10305



SPILLWAY RATING CURVE

ELEV.	Q	ARCH	TOT.
784.5	3	5	8
785.0	6	10	16
786.0	10	22	32
787.0	14	43	57
788.0	17	56	73
789.0	20	64	84
790.0	23	76	99
791.0	25	88	109
792.0	27	94	118
793.0	30	104	134

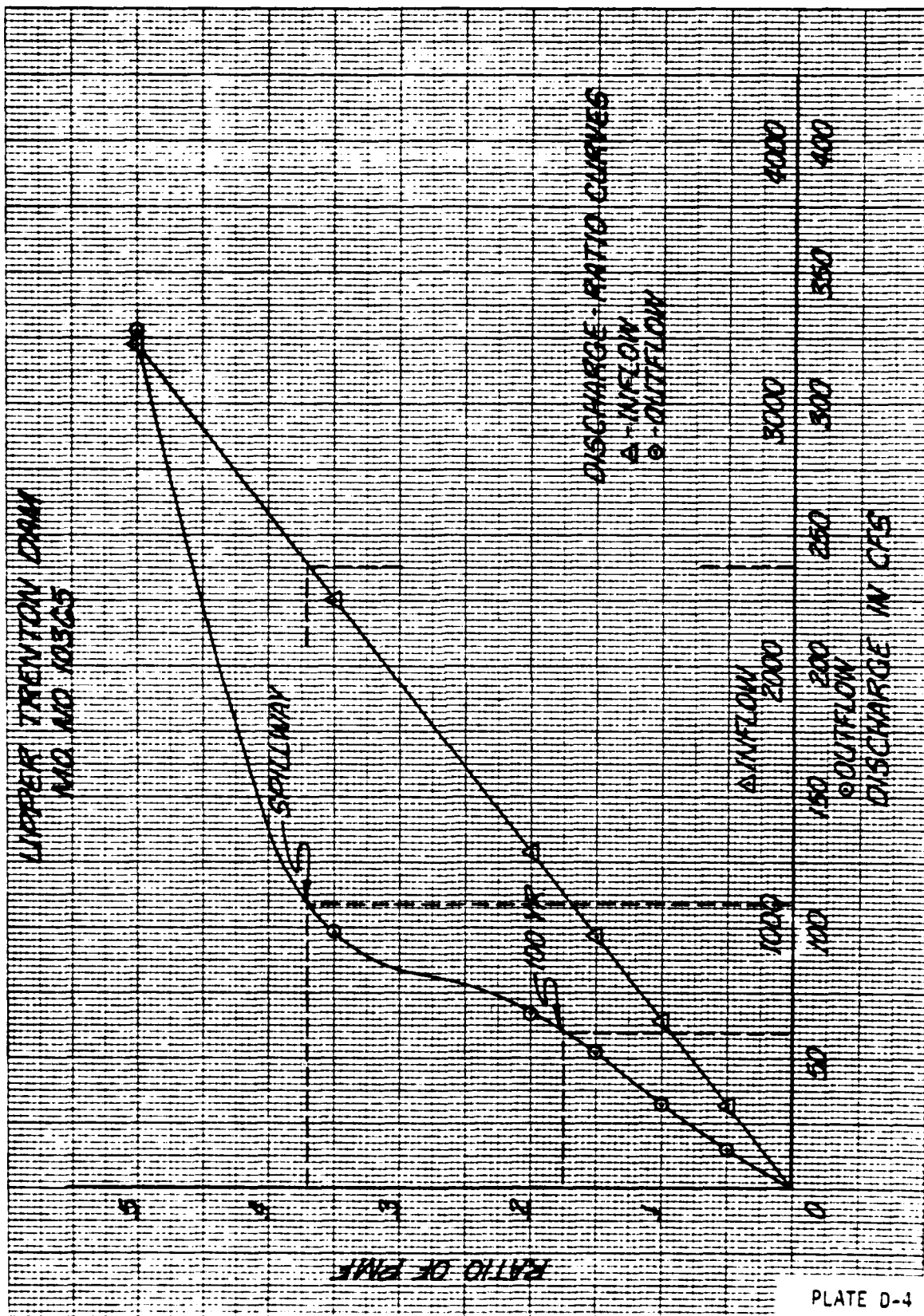


PLATE D-4

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

ROUTE HYDROGRAPH AT 000001
ROUTE HYDROGRAPH TO 000002
ROUTE HYDROGRAPH AT 000001
COMBINE 2 HYDROGRAPHS AT M 2+3
ROUTE HYDROGRAPH TO 000004
END OF NETWORK

 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF TRENCH LAKE DAM 10365
 JULY 1978
 LAST MODIFICATION 26 FEB 79

DATE: 7/27/78
 TIME: 11:00 AM

ANALYSIS OF DAM OVERTOPPING USING RAIUS IN PNE
 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF TRENCH LAKE DAM 10365
 RATIOS OF PNE ROUTED THROUGH THE RESERVOIR

JOB SPECIFICATION									
IC	THR	NRIN	IDAY	TDW	ININ	MTRC	IPLT	IPRT	INSTAN
294	0	5	0	0	0	0	0	3	0
		JOPER	NMT	LKPT	TRACE				
		5	0	0	0				

MULTI-PLAN ANALYSES TO BE PERFORMED

NPLA= 1 NPLIO= 9 NPLIO= 1
 RATIOS= .05 .10 .15 .20 .35 .50 .65 .80 1.00

SUB-AREA RUMIFF COMPUTATION

CALCULATION OF INFLO HYDRO TO RES 10365

ISTAQ	TCOMP	TECON	ITAPE	JPLI	JPRI	IRAME	ISTAGL	IAUTO
00001	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INRUG	INRUG	TAETA	SNAP	TRSDA	TRSPC	RATIO	TSNOM	TSAME	LOCAL
1	2	.40	0.00	.90	1.00	0.000	0	1	0

PACUP DATA

SPR1	PMS	RG	R12	R24	K48	R72	R96
0.00	24.00	102.00	121.00	140.00	0.00	0.00	0.00

LOSS DATA

LOUPL	STARR	DIETR	RTIOL	ENRIN	STIKS	RTIOL	STIRL	CHSTL	ALSMK	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-94.00	0.00	0.00

LOUPL 00 = -94.00 NETLOSS = -1.00 EFFECT UP = 94.00

UNIT HYDROGRAPH DATA

IC= 0.00 IAGA= .97

RELATION DATA

STIRL= 0.00 GRCD= .001 RTIOL= 1.00

UNIT HYDROGRAPH TO END OF PERIOD ORIGINATES, IC= 0.00 HOURS, IAGA= .97 VAL= 1.00
 0.00 1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00 9.00 10.00 11.00 12.00 13.00 14.00 15.00 16.00 17.00 18.00 19.00 20.00 21.00 22.00 23.00 24.00 25.00 26.00 27.00 28.00 29.00 30.00 31.00 32.00 33.00 34.00 35.00 36.00 37.00 38.00 39.00 40.00 41.00 42.00 43.00 44.00 45.00 46.00 47.00 48.00 49.00 50.00 51.00 52.00 53.00 54.00 55.00 56.00 57.00 58.00 59.00 60.00 61.00 62.00 63.00 64.00 65.00 66.00 67.00 68.00 69.00 70.00 71.00 72.00 73.00 74.00 75.00 76.00 77.00 78.00 79.00 80.00 81.00 82.00 83.00 84.00 85.00 86.00 87.00 88.00 89.00 90.00 91.00 92.00 93.00 94.00 95.00 96.00 97.00 98.00 99.00 100.00

HYDROGRAPH AT STA0000 FOR PLAN 1, RTIO 9 **PMF**

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
LES	6.46.	2313.	733.	733.	211161.
CMS	1846.	65.	21.	21.	5979.
HCPCS		23.	30.31	30.31	30.31
PP		607.14	769.95	769.95	769.95
AC-FT		1147.	1454.	1454.	1454.
THOUS CU M		1415.	1794.	1794.	1794.

HYDROGRAPHI KUNTING

RECEIVED FROM THE RES 10365

ISTAC	ICOMP	IECON	ITAPE	JPLI	JPKT	INAME	ISTAGE	IAUTO
000012	1	0	0	2	0	1	0	0

ROUTING DATA	AVG	IRIS	ISAME	IUPT	IPMP	ISTR
0.00	0.00	1	1	0	0	0

	STATUS	SOLID	LAG	AMSKK	X	TSK	STORA	ISPRAT
	1	0	0	0.000	0.000	0.000	-784.	-1
DISTANCE	786.50	785.00	786.00	787.00	788.00	789.00	790.00	792.00
FLOW	0.00	16.00	33.00	57.00	73.00	86.00	99.00	118.00
CAPACITY	0.	170.	300.	465.	689.	820.	970.	1150.
ELEVATION	101.	775.	780.	784.	786.	788.	790.	794.

DAM DATA		
TUPEL	COQU	EXPD
791.0	2.9	1.5
		1145.

CRACKS IN CONCRETE AT THE CLUTCH PLATE	0.	115.	225.	570.	660.	955.	1145.
CLUTCH FORCE	101.0	791.5	792.1	792.5	792.9	793.1	793.9

STATION 000002, PLAN 1, PAGE 1

2025-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55-56-57-58-59-60-61-62-63-64-65-66-67-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83-84-85-86-87-88-89-90-91-92-93-94-95-96-97-98-99-100-101-102-103-104-105-106-107-108-109-110-111-112-113-114-115-116-117-118-119-120-121-122-123-124-125-126-127-128-129-130-131-132-133-134-135-136-137-138-139-140-141-142-143-144-145-146-147-148-149-150-151-152-153-154-155-156-157-158-159-160-161-162-163-164-165-166-167-168-169-170-171-172-173-174-175-176-177-178-179-180-181-182-183-184-185-186-187-188-189-190-191-192-193-194-195-196-197-198-199-200-201-202-203-204-205-206-207-208-209-210-211-212-213-214-215-216-217-218-219-220-221-222-223-224-225-226-227-228-229-230-231-232-233-234-235-236-237-238-239-240-241-242-243-244-245-246-247-248-249-250-251-252-253-254-255-256-257-258-259-260-261-262-263-264-265-266-267-268-269-270-271-272-273-274-275-276-277-278-279-280-281-282-283-284-285-286-287-288-289-290-291-292-293-294-295-296-297-298-299-300-301-302-303-304-305-306-307-308-309-310-311-312-313-314-315-316-317-318-319-320-321-322-323-324-325-326-327-328-329-330-331-332-333-334-335-336-337-338-339-340-341-342-343-344-345-346-347-348-349-350-351-352-353-354-355-356-357-358-359-360-361-362-363-364-365-366-367-368-369-370-371-372-373-374-375-376-377-378-379-380-381-382-383-384-385-386-387-388-389-390-391-392-393-394-395-396-397-398-399-400-401-402-403-404-405-406-407-408-409-410-411-412-413-414-415-416-417-418-419-420-421-422-423-424-425-426-427-428-429-430-431-432-433-434-435-436-437-438-439-440-441-442-443-444-445-446-447-448-449-450-451-452-453-454-455-456-457-458-459-460-461-462-463-464-465-466-467-468-469-470-471-472-473-474-475-476-477-478-479-480-481-482-483-484-485-486-487-488-489-490-491-492-493-494-495-496-497-498-499-500-501-502-503-504-505-506-507-508-509-510-511-512-513-514-515-516-517-518-519-520-521-522-523-524-525-526-527-528-529-530-531-532-533-534-535-536-537-538-539-540-541-542-543-544-545-546-547-548-549-550-551-552-553-554-555-556-557-558-559-560-561-562-563-564-565-566-567-568-569-570-571-572-573-574-575-576-577-578-579-580-581-582-583-584-585-586-587-588-589-590-591-592-593-594-595-596-597-598-599-600-601-602-603-604-605-606-607-608-609-610-611-612-613-614-615-616-617-618-619-620-621-622-623-624-625-626-627-628-629-630-631-632-633-634-635-636-637-638-639-640-641-642-643-644-645-646-647-648-649-650-651-652-653-654-655-656-657-658-659-660-661-662-663-664-665-666-667-668-669-670-671-672-673-674-675-676-677-678-679-680-681-682-683-684-685-686-687-688-689-690-691-692-693-694-695-696-697-698-699-700-701-702-703-704-705-706-707-708-709-710-711-712-713-714-715-716-717-718-719-720-721-722-723-724-725-726-727-728-729-730-731-732-733-734-735-736-737-738-739-740-741-742-743-744-745-746-747-748-749-750-751-752-753-754-755-756-757-758-759-760-761-762-763-764-765-766-767-768-769-770-771-772-773-774-775-776-777-778-779-780-781-782-783-784-785-786-787-788-789-790-791-792-793-794-795-796-797-798-799-800-801-802-803-804-805-806-807-808-809-810-811-812-813-814-815-816-817-818-819-820-821-822-823-824-825-826-827-828-829-830-831-832-833-834-835-836-837-838-839-840-841-842-843-844-845-846-847-848-849-850-851-852-853-854-855-856-857-858-859-860-861-862-863-864-865-866-867-868-869-870-871-872-873-874-875-876-877-878-879-880-881-882-883-884-885-886-887-888-889-890-891-892-893-894-895-896-897-898-899-900-901-902-903-904-905-906-907-908-909-910-911-912-913-914-915-916-917-918-919-920-921-922-923-924-925-926-927-928-929-930-931-932-933-934-935-936-937-938-939-940-941-942-943-944-945-946-947-948-949-950-951-952-953-954-955-956-957-958-959-960-961-962-963-964-965-966-967-968-969-970-971-972-973-974-975-976-977-978-979-980-981-982-983-984-985-986-987-988-989-990-991-992-993-994-995-996-997-998-999-1000-1001-1002-1003-1004-1005-1006-1007-1008-1009-1010-1011-1012-1013-1014-1015-1016-1017-1018-1019-1020-1021-1022-1023-1024-1025-1026-1027-1028-1029-1030-1031-1032-1033-1034-1035-1036-1037-1038-1039-1040-1041-1042-1043-1044-1045-1046-1047-1048-1049-1050-1051-105

STATION WCCO2, PLAN 1, PAGE 9

END-OF-PERIOD HYDROGRAPH ORIGINATES

[illegible]

STORAGE

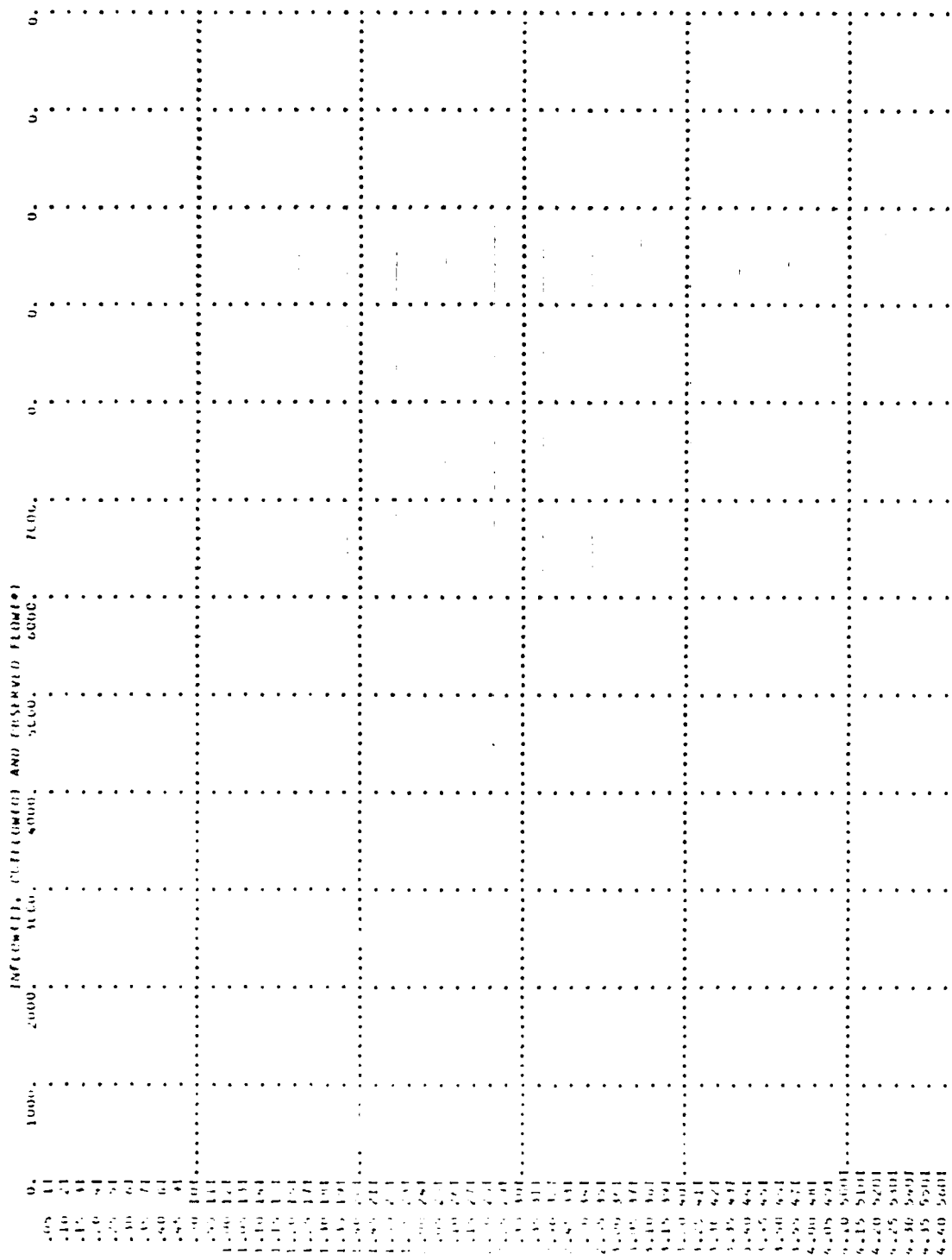
6391.	6631.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.	6891.
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

[illegible]

PAK WILLOW IS 4602. AT TIME 16.33 HOURS

	PEAK	6-HOUM	24-HOUM	72-HOUM	TOTAL
CFS	460.2	156.0	42.0	42.0	1233.2
CMS	130.	4.4	1.2	1.2	34.6
INCHES		15.78	17.71	17.71	17.71
PM		405.77	449.92	449.92	449.92
AC-FI		76.0	85.0	85.0	85.0
THOUC. CU. F.		94.5	104.8	104.8	104.8

STATION 6602



8.45 8731
8.50 8801
8.55 8901
9.00 9001
9.05 9101
9.10 9201
9.15 9301
9.20 9401
9.25 9501
9.30 9601
9.35 9701
9.40 9801
9.45 9901
9.50 1001
9.55 1101
10.00 1201
10.05 1301
10.10 1401
10.15 1501
10.20 1601
10.25 1701
10.30 1801
10.35 1901
10.40 2001
10.45 2101
10.50 2201
10.55 2301
11.00 2401
11.05 2501
11.10 2601
11.15 2701
11.20 2801
11.25 2901
11.30 3001
11.35 3101
11.40 3201
11.45 3301
11.50 3401
11.55 3501
12.00 3601
12.05 3701
12.10 3801
12.15 3901
12.20 4001
12.25 4101
12.30 4201
12.35 4301
12.40 4401
12.45 4501
12.50 4601
12.55 4701
13.00 4801
13.05 4901
13.10 5001
13.15 5101
13.20 5201
13.25 5301
13.30 5401
13.35 5501
13.40 5601
13.45 5701
13.50 5801
13.55 5901
14.00 6001
14.05 6101
14.10 6201
14.15 6301
14.20 6401
14.25 6501
14.30 6601
14.35 6701
14.40 6801
14.45 6901
14.50 7001
14.55 7101
15.00 7201
15.05 7301
15.10 7401
15.15 7501
15.20 7601
15.25 7701
15.30 7801
15.35 7901
15.40 8001
15.45 8101
15.50 8201
15.55 8301
16.00 8401
16.05 8501
16.10 8601
16.15 8701
16.20 8801
16.25 8901
16.30 9001
16.35 9101
16.40 9201
16.45 9301
16.50 9401
16.55 9501
17.00 9601
17.05 9701
17.10 9801
17.15 9901
17.20 10001
17.25 10101
17.30 10201
17.35 10301
17.40 10401
17.45 10501
17.50 10601
17.55 10701
18.00 10801
18.05 10901
18.10 11001
18.15 11101
18.20 11201
18.25 11301
18.30 11401
18.35 11501
18.40 11601
18.45 11701
18.50 11801
18.55 11901
19.00 12001
19.05 12101
19.10 12201
19.15 12301
19.20 12401
19.25 12501
19.30 12601
19.35 12701
19.40 12801
19.45 12901
19.50 13001
19.55 13101
20.00 13201
20.05 13301
20.10 13401
20.15 13501
20.20 13601
20.25 13701
20.30 13801
20.35 13901
20.40 14001
20.45 14101
20.50 14201
20.55 14301
21.00 14401
21.05 14501
21.10 14601
21.15 14701
21.20 14801
21.25 14901
21.30 15001
21.35 15101
21.40 15201
21.45 15301
21.50 15401
21.55 15501
22.00 15601
22.05 15701
22.10 15801
22.15 15901
22.20 16001
22.25 16101
22.30 16201
22.35 16301
22.40 16401
22.45 16501
22.50 16601
22.55 16701
23.00 16801
23.05 16901
23.10 17001
23.15 17101
23.20 17201
23.25 17301
23.30 17401
23.35 17501
23.40 17601
23.45 17701
23.50 17801
23.55 17901
24.00 18001
24.05 18101
24.10 18201
24.15 18301
24.20 18401
24.25 18501
24.30 18601
24.35 18701
24.40 18801
24.45 18901
24.50 19001
24.55 19101
25.00 19201
25.05 19301
25.10 19401
25.15 19501
25.20 19601
25.25 19701
25.30 19801
25.35 19901
25.40 20001
25.45 20101
25.50 20201
25.55 20301
26.00 20401
26.05 20501
26.10 20601
26.15 20701
26.20 20801
26.25 20901
26.30 21001
26.35 21101
26.40 21201
26.45 21301
26.50 21401
26.55 21501
27.00 21601
27.05 21701
27.10 21801
27.15 21901
27.20 22001
27.25 22101
27.30 22201
27.35 22301
27.40 22401
27.45 22501
27.50 22601
27.55 22701
28.00 22801
28.05 22901
28.10 23001
28.15 23101
28.20 23201
28.25 23301
28.30 23401
28.35 23501
28.40 23601
28.45 23701
28.50 23801
28.55 23901
29.00 24001
29.05 24101
29.10 24201
29.15 24301
29.20 24401
29.25 24501
29.30 24601
29.35 24701
29.40 24801
29.45 24901
29.50 25001
29.55 25101
30.00 25201
30.05 25301
30.10 25401
30.15 25501
30.20 25601
30.25 25701
30.30 25801
30.35 25901
30.40 26001
30.45 26101
30.50 26201
30.55 26301
31.00 26401
31.05 26501
31.10 26601
31.15 26701
31.20 26801
31.25 26901
31.30 27001
31.35 27101
31.40 27201
31.45 27301
31.50 27401
31.55 27501
32.00 27601
32.05 27701
32.10 27801
32.15 27901
32.20 28001
32.25 28101
32.30 28201
32.35 28301
32.40 28401
32.45 28501
32.50 28601
32.55 28701
33.00 28801
33.05 28901
33.10 29001
33.15 29101
33.20 29201
33.25 29301
33.30 29401
33.35 29501
33.40 29601
33.45 29701
33.50 29801
33.55 29901
34.00 30001
34.05 30101
34.10 30201
34.15 30301
34.20 30401
34.25 30501
34.30 30601
34.35 30701
34.40 30801
34.45 30901
34.50 31001
34.55 31101
35.00 31201
35.05 31301
35.10 31401
35.15 31501
35.20 31601
35.25 31701
35.30 31801
35.35 31901
35.40 32001
35.45 32101
35.50 32201
35.55 32301
36.00 32401
36.05 32501
36.10 32601
36.15 32701
36.20 32801
36.25 32901
36.30 33001
36.35 33101
36.40 33201
36.45 33301
36.50 33401
36.55 33501
37.00 33601
37.05 33701
37.10 33801
37.15 33901
37.20 34001
37.25 34101
37.30 34201
37.35 34301
37.40 34401
37.45 34501
37.50 34601
37.55 34701
38.00 34801
38.05 34901
38.10 35001
38.15 35101
38.20 35201
38.25 35301
38.30 35401
38.35 35501
38.40 35601
38.45 35701
38.50 35801
38.55 35901
39.00 36001
39.05 36101
39.10 36201
39.15 36301
39.20 36401
39.25 36501
39.30 36601
39.35 36701
39.40 36801
39.45 36901
39.50 37001
39.55 37101
40.00 37201
40.05 37301
40.10 37401
40.15 37501
40.20 37601
40.25 37701
40.30 37801
40.35 37901
40.40 38001
40.45 38101
40.50 38201
40.55 38301
41.00 38401
41.05 38501
41.10 38601
41.15 38701
41.20 38801
41.25 38901
41.30 39001
41.35 39101
41.40 39201
41.45 39301
41.50 39401
41.55 39501
42.00 39601
42.05 39701
42.10 39801
42.15 39901
42.20 40001
42.25 40101
42.30 40201
42.35 40301
42.40 40401
42.45 40501
42.50 40601
42.55 40701
43.00 40801
43.05 40901
43.10 41001
43.15 41101
43.20 41201
43.25 41301
43.30 41401
43.35 41501
43.40 41601
43.45 41701
43.50 41801
43.55 41901
44.00 42001
44.05 42101
44.10 42201
44.15 42301
44.20 42401
44.25 42501
44.30 42601
44.35 42701
44.40 42801
44.45 42901
44.50 43001
44.55 43101
45.00 43201
45.05 43301
45.10 43401
45.15 43501
45.20 43601
45.25 43701
45.30 43801
45.35 43901
45.40 44001
45.45 44101
45.50 44201
45.55 44301
46.00 44401
46.05 44501
46.10 44601
46.15 44701
46.20 44801
46.25 44901
46.30 45001
46.35 45101
46.40 45201
46.45 45301
46.50 45401
46.55 45501
47.00 45601
47.05 45701
47.10 45801
47.15 45901
47.20 46001
47.25 46101
47.30 46201
47.35 46301
47.40 46401
47.45 46501
47.50 46601
47.55 46701
48.00 46801
48.05 46901
48.10 47001
48.15 47101
48.20 47201
48.25 47301
48.30 47401
48.35 47501
48.40 47601
48.45 47701
48.50 47801
48.55 47901
49.00 48001
49.05 48101
49.10 48201
49.15 48301
49.20 48401
49.25 48501
49.30 48601
49.35 48701
49.40 48801
49.45 48901
49.50 49001
49.55 49101
50.00 49201
50.05 49301
50.10 49401
50.15 49501
50.20 49601
50.25 49701
50.30 49801
50.35 49901
50.40 50001
50.45 50101
50.50 50201
50.55 50301
51.00 50401
51.05 50501
51.10 50601
51.15 50701
51.20 50801
51.25 50901
51.30 51001
51.35 51101
51.40 51201
51.45 51301
51.50 51401
51.55 51501
52.00 51601
52.05 51701
52.10 51801
52.15 51901
52.20 52001
52.25 52101
52.30 52201
52.35 52301
52.40 52401
52.45 52501
52.50 52601
52.55 52701
53.00 52801
53.05 52901
53.10 53001
53.15 53101
53.20 53201
53.25 53301
53.30 53401
53.35 53501
53.40 53601
53.45 53701
53.50 53801
53.55 53901
54.00 54001
54.05 54101
54.10 54201
54.15 54301
54.20 54401
54.25 54501
54.30 54601
54.35 54701
54.40 54801
54.45 54901
54.50 55001
54.55 55101
55.00 55201
55.05 55301
55.10 55401
55.15 55501
55.20 55601
55.25 55701
55.30 55801
55.35 55901
55.40 56001
55.45 56101
55.50 56201
55.55 56301
56.00 56401
56.05 56501
56.10 56601
56.15 56701
56.20 56801
56.25 56901
56.30 57001
56.35 57101
56.40 57201
56.45 57301
56.50 57401
56.55 57501
57.00 57601
57.05 57701
57.10 57801
57.15 57901
57.20 58001
57.25 58101
57.30 58201
57.35 58301
57.40 58401
57.45 58501
57.50 58601
57.55 58701
58.00 58801
58.05 58901
58.10 590

9.55190
 10.001200
 10.051210
 10.101220
 10.151230
 10.201240
 10.251250
 10.301260
 10.351270
 10.401280
 10.451290
 10.501300
 10.551310
 11.001320
 11.051330
 11.101340
 11.151350
 11.201360
 11.251370
 11.301380
 11.351390
 11.401400
 11.451410
 11.501420
 11.551430
 12.001440
 12.051450
 12.101460
 12.151470
 12.201480
 12.251490
 12.301500
 12.351510
 12.401520
 12.451530
 12.501540
 12.551550
 13.001560
 13.051570
 13.101580
 13.151590
 13.201600
 13.251610
 13.301620
 13.351630
 13.401640
 13.451650
 13.501660
 13.551670
 14.001680
 14.051690
 14.101700
 14.151710
 14.201720
 14.251730
 14.301740
 14.351750
 14.401760
 14.451770
 14.501780
 14.551790
 15.001800

PLATE D-15

20.15243.1 0
 20.20244.1 0
 20.25245.1 0
 20.30246.1 0
 20.35247.1 0
 20.40248.1 0
 20.45249.1 0
 20.50250.1 0
 20.55251.1 0
 21.00252.1 0
 21.05253.1 0
 21.10254.1 0
 21.15255.1 0
 21.20256.1 0
 21.25257.1 0
 21.30258.1 0
 21.35259.1 0
 21.40260.1 0
 21.45261.1 0
 21.50262.1 0
 21.55263.1 0
 22.00264.1 0
 22.05265.1 0
 22.10266.10
 22.15267.10
 22.20268.10
 22.25269.10
 22.30270.10
 22.35271.10
 22.40272.10
 22.45273.10
 22.50274.10
 22.55275.10
 23.00276.10
 23.05277.10
 23.10278.10
 23.15279.10
 23.20280.10
 23.25281.10
 23.30282.10
 23.35283.10
 23.40284.10
 23.45285.10
 23.50286.10
 23.55287.10
 0.00288.10

PLAN FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILLS (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN RATIO	RATIOS APPLIED TO FLOWS								
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
				.05	.10	.15	.20	.25	.30	.35	.40	.45
HYDROGRAPH AT	000001	2.33	1	322.	652.	967.	1289.	2256.	3223.	4190.	5157.	6446.
				9.1331	18.2531	27.3831	36.5131	63.8931	91.2731	118.6531	146.0331	182.5431
ADJUSTED TO	000002	2.33	1	16.	32.	52.	67.	98.	127.	1128.	2296.	4602.
				.4431	.9131	1.4831	1.9131	2.7631	3.2731	31.9531	64.9531	130.3131
HYDROGRAPH AT	000003	2.33	1	215.	431.	646.	861.	1507.	2153.	2799.	3445.	4307.
				6.1031	12.1931	18.2931	24.3931	42.6831	60.9731	79.2731	97.5631	121.9531
2 COMBINED	M 000004	2.89	1	223.	446.	669.	892.	1566.	2230.	2890.	3548.	5082.
				6.3131	12.6231	18.9331	25.2731	44.3531	63.1531	81.8231	100.4631	141.9131
ADJUSTED TO	000005	2.89	1	4.	9.	16.	24.	47.	91.	553.	1976.	4105.
				.1231	.2431	.4531	.6831	1.3331	2.5831	15.6531	55.8931	121.8931

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 RES. 10.345

RATIO OF PHE	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	INITIAL VALUE 784.00 689. 0.	SPILLWAY CREST 784.00 689. 0.	TOP OF DAM 791.00 1240. 109.	DURATION OVER TOP HOURS	MAXIMUM OUTFLOW CFS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.05	784.91	0.00	753.	16.	0.00	0.00	19.00	0.00	0.00
.10	785.95	0.00	817.	32.	0.00	0.00	19.00	0.00	0.00
.15	786.81	0.00	941.	52.	0.00	0.00	18.92	0.00	0.00
.20	787.45	0.00	944.	67.	0.00	0.00	18.92	0.00	0.00
.35	789.00	0.00	1140.	98.	0.00	0.00	19.08	0.00	0.00
.50	791.80	0.00	1321.	327.	0.00	0.00	18.67	0.00	0.00
.65	792.61	1.81	1395.	1128.	7.72	17.67	0.00	0.00	0.00
.80	793.67	2.07	1443.	2294.	8.25	16.67	0.00	0.00	0.00
1.00	793.62	2.62	1500.	4602.	8.83	16.33	0.00	0.00	0.00

DATE
ILME